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Hymenochaete cifuentesii, H. potosina, and H. raduloides spp. nov. from the tropical dry forest of Mexico

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Abstract—Three new species, *Hymenochaete cifuentesii*, *H. potosina*, and *H. raduloides*, are described and illustrated from Mexico. The specimens were collected in San Luis Potosí State in a tropical dry forest. Holotypes are deposited in ENCB Herbarium with isotypes in UAMIZ.

Key words—*Agaricomycetes*, fungal diversity, *Hymenochaetaceae*, taxonomy

Introduction

Hymenochaete Lév. is the type genus of *Hymenochaetaceae* Donk and *Hymenochaetales* Oberw. It includes annual to perennial species characterized by resupinate, effused-reflexed, or pileate (sessile and stipitate) basidiomata with papery, coriaceous, or woody contexts; smooth, warted, folded, cracked, or hydnoid hymenophores with numerous setae; occasional crystals or granulations between or covering the hyphae; basidiomata brown often with reddish brown, yellowish, gold, or mustard hues; a color darkening in KOH (xanthocroic reaction); and a monomitic or pseudodimitic hyphal system with simple septa (Léger 1998, Parmasto 2001, He & Dai 2012, Parmasto & al. 2014). More than 130 species have been described in *Hymenochaete,* (one of the largest genera in *Hymenochaetaceae*), all of which cause white fibrous or pocket rot in dead wood (Parmasto 2001, Parmasto & al. 2014).

Twenty-one species have been reported from Mexico: *Hymenochaete allantospora* Parmasto, *H. americana* Gresl. & Parmasto, *H. carpatica* Pilát, *H. cervina* Berk & M.A. Curtis, *H. cinnamomea* (Pers.) Bres., *H. curtisii* (Berk.) Morgan, *H. damicornis* (Link) Lév., *H. epichlora* (Berk. & M.A. Curtis) Cooke, *H. episphaeria* (Schwein.) Massee, *H. escobarii* J.C. Léger, *H. digitata* Burt, *H. fulva* Burt, *H. leonina* Berk. & M.A. Curtis, *H. luteobadia* (Fr.) Höhn. & Litsch., *H. opaca* Burt, *H. pinnatifida* Burt, *H. resupinata* (Sw.) Parmasto, *H. rhabarbarina* (Berk.) Cooke, *H. rheicolor* (Mont.) Lév., *H. rubiginosa* (Dicks.) Lév., and *H. unicolor* Berk. & M.A. Curtis (Welden & Lemke 1961; Reeves & Welden 1967; Marmolejo & al. 1981; Valenzuela & al. 1996; Léger 1998; Parmasto 2001; Pérez-Ramírez 2002, Montaño & al. 2006; Raymundo & al. 2009, 2013; Vázquez-Mendoza & Valenzuela 2010).

During taxonomic work in the tropical dry forest from State of San Luis Potosí, Mexico, several *Hymenochaete* specimens presented distinct morphotypes that could not be satisfactorily accommodated in any previously described species. Here we describe and illustrate three new *Hymenochaete* species associated with the tropical dry forest of Mexico.

Materials & methods

The specimens were collected in 2006, 2007, and 2009 from the tropical dry forest of the Río Verde municipality, Tamasopo, San Luis Potosí State, Mexico. They are deposited in the fungi collection "Dr. Gastón Guzmán Huerta" at the Herbarium of the Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Mexico City, Mexico (ENCB) with duplicates in Herbarium, Universidad Autónoma Metropolitana–Iztapalapa, Mexico City, Mexico (UAMIZ). Longitudes and latitudes were obtained with a Garmin eTrex® GPS. Color codes follow the Munsell Color Company (M; 1954) soil color chart and Kornerup & Wanscher (KW; 1978). Morphological examinations followed protocols outlined by Léger (1998) and Parmasto (2001). Anatomical elements were measured in 5% aqueous KOH or Melzer's reagent from rehydrated tissues. Macroscopic features were photographed with a Nikon D7000 camera, and microscopic elements with a Nikon Coolpix 9000 camera. Most terminology follows Ulloa & Hanlin (2012).

Taxonomy

Hymenochaete cifuentesii Contr.-Pach., R. Valenz., Raymundo & Pacheco, **sp. nov.**

PLATES 1, 2, 7.A

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Differs from *Hymenochaete americana* by its shorter, ellipsoid to oblong spores; its abundant, lanceolate, slightly curved setae growing parallel to hyphae that deposit reddish granules into cambium cells; and its habitat in a tropical dry forest.

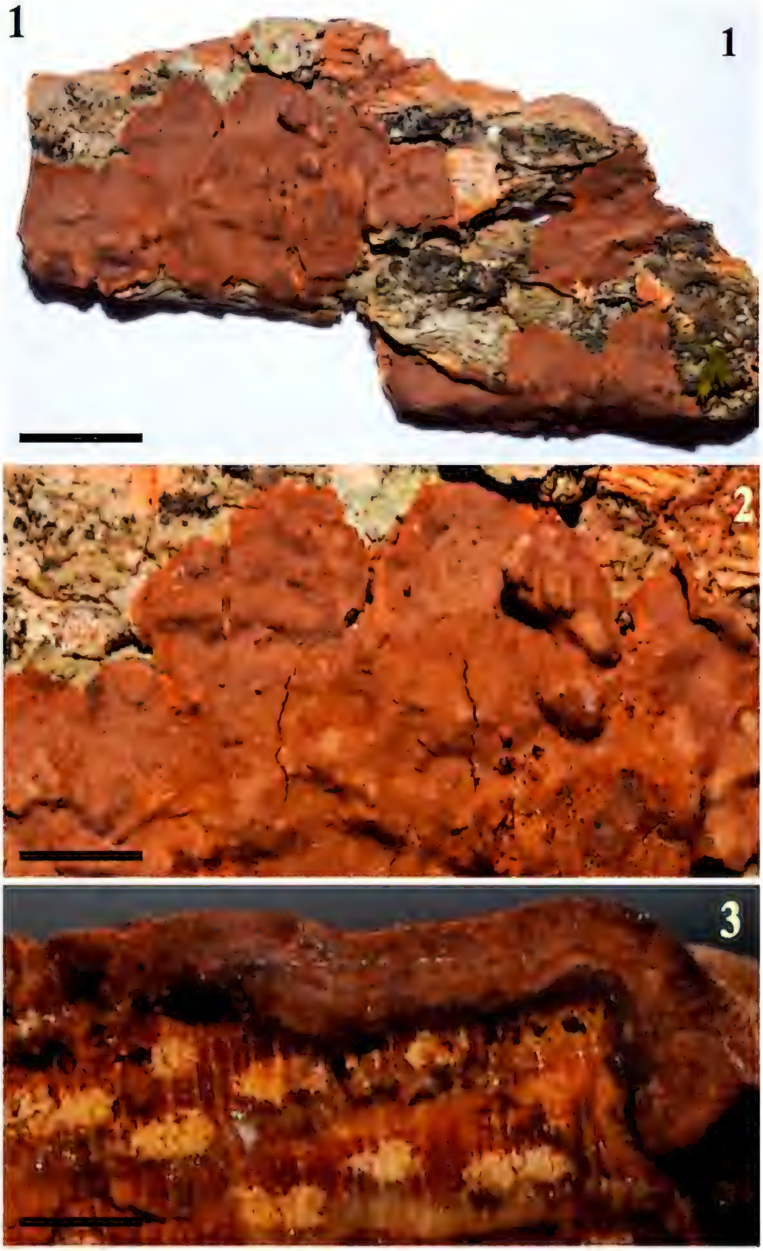

Plate 1. *Hymenochaete cifuentesii* (holotype, ENCB: Raymundo & Valenzuela 1281). 1. Basidiome on substrate; 2. Margin of the basidiome; 3. Basidiome, cross-section.

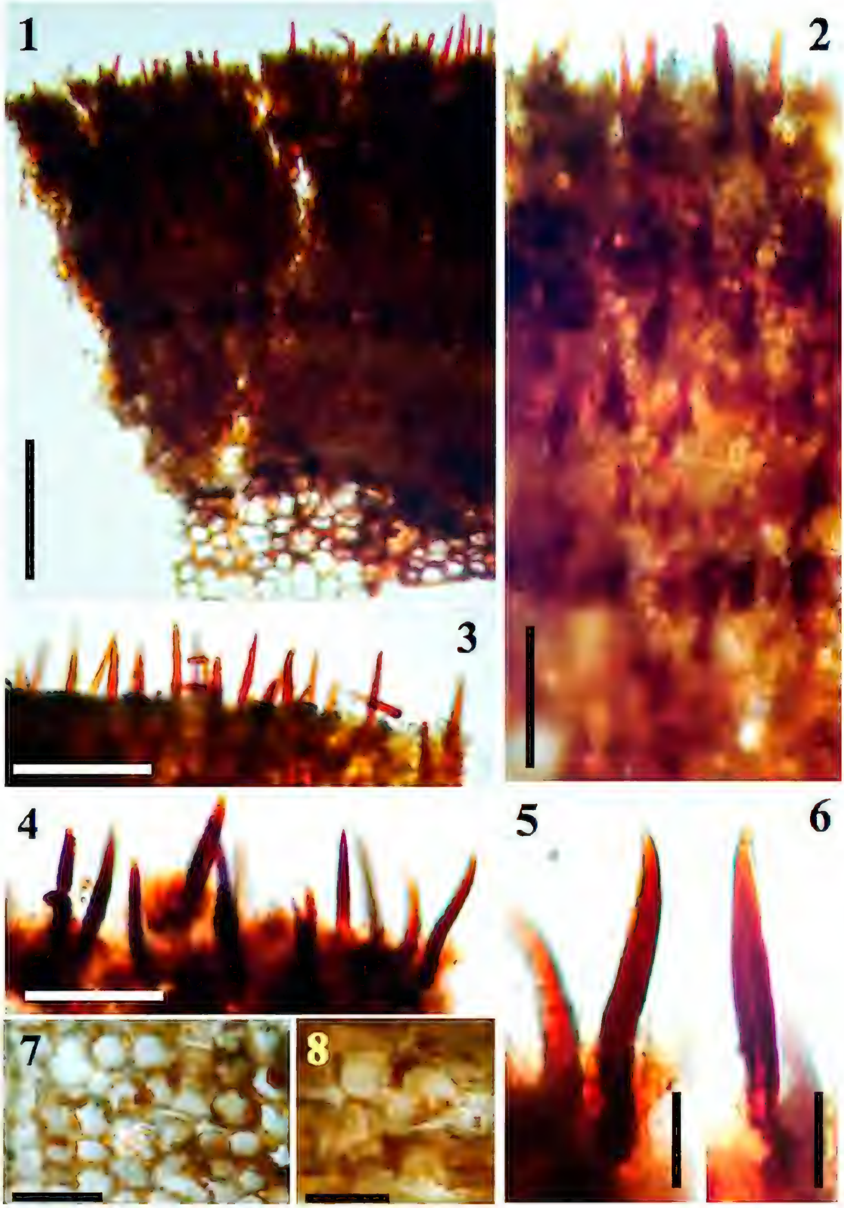

Plate 2. *Hymenochaete cifuentesii* (holotype, ENCB: Raymundo & Valenzuela 1281). 1, 2. Basidiome, cross-section; 3–6. Setae; 7, 8. Plant substrate cambium cells showing granules.

Type: Mexico, San Luis Potosí State, municipality of Río Verde, km 70 Ciudad Valles–Río Verde road, 22°32′17″N 100°29′13″W, alt. 900 m, 26 November 2006, T. Raymundo & R. Valenzuela 1281 (**Holotype**, ENCB; **isotype**, UAMIZ).

Etymology: In honor of our adviser, Professor Joaquín Cifuentes Blanco, a great Mexican mycologist.

Basidiome resupinate, closely adnate, corky, 57–97 × 20–30 mm diam, 0.4–0.5 mm thick, pale brown (M: 10YR 5/8; KW: 7E5). Hymenophore smooth, with scattered tubercules, zonate, not cracked. Margin abrupt, sterile with setae, dark yellowish brown (M: 10YR 6/8; KW: 5E7). Cortex and tomentum absent. Hymenium 47–57 µm thick, subiculum <560 µm thick, with numerous stratified and parallel aligned setae and hyphae. Hyphal system monomitic, generative hyphae of two types: a) in subhymenium and subiculum hyaline, 1–1.5 µm diam, simple septa; b) in subiculum with slightly thickened (<1 µm) walls, reddish brown to dark brown in KOH, 1.6–3.2 µm diam, simple septa; subiculum hyphae growing into the bark to deposit reddish granules within the cambium cells. Setae 52–110 × 6–15 µm, lanceolate, slightly curved, abundant, reddish brown to dark brown in KOH, projecting <30 µm; the acute tip encrusted with crystals and the base with hyphae interwoven compactly. Basidia 20–28 × 4–6.4 µm, subclavate, tetrasporic, sterigmata 2.4–4 µm long. Basidiospores 5–7.6 × 2.4–4 µm, ellipsoid to oblong, hyaline, thin-walled, smooth.

Ecology and distribution—*Hymenochaete cifuentesii* grows gregariously on fallen and dead angiosperm twigs in tropical dry forest and causes a pocket rot. Known only from the type locality.

Additional specimen examined—MEXICO. San Luis Potosí, municipality of Río Verde, km 70 Ciudad Valle–Río Verde road, 1 November 2007, T. Raymundo & R. Valenzuela 1276 (ENCB).

Comments—*Hymenochaete cifuentesii* belongs to *Hymenochaete* sect. *Fultochaete*, which Léger (1998) characterizes as species having a setal layer and lacking a cortex and tomentum; Our new species, which differs from other species in the section by its parallel orientation of hyphae and setae is similar to *H. americana*, which is distinguished by its chocolate brown color and longer, cylindrical to slightly curved (almost sigmoid) spores (7.5–9.2 × 2.5–3 µm; Parmasto 2001). *Hymenochaete livens* Bres. differs by its light brown color, and its wider setae (60–100 × 12–20 µm; Léger 1998). *Hymenochaete spreta* Peck [≡ *H. cinnamomea* subsp. *spreta* (Peck) Parmasto] differs by its numerous longer (70–120 × 5–9 µm) non-incrusted setae and smaller (4.5–6.5(7) × 1.8–2.8(3.2) µm) spores (Parmasto 2001, as *H. cinnamomea* subsp. *spreta*).

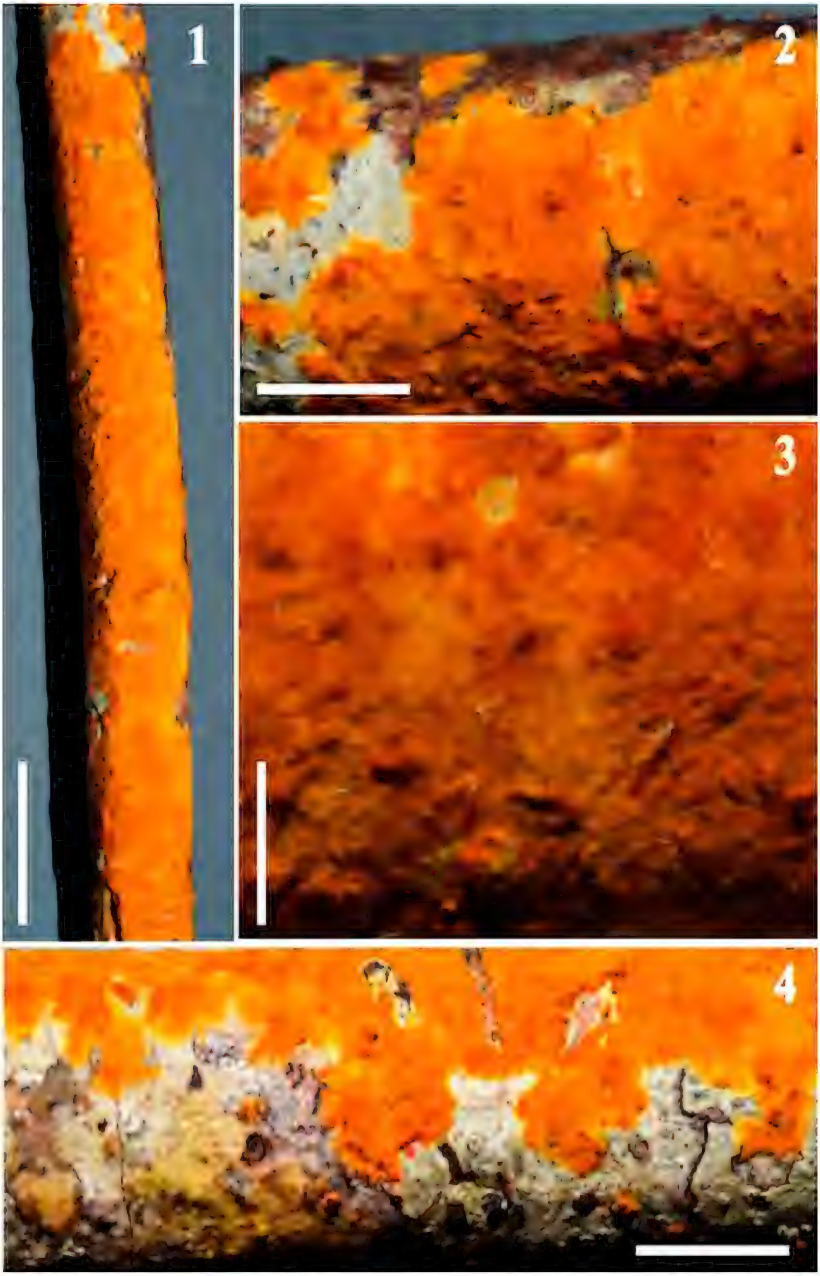

PLATE 3. *Hymenochaete potosina* (holotype, ENCB: Valenzuela 13381). 1. Resupinate basidiome; 2. Basidiome on substrate; 3. Hymenophore; 4. Basidiome margin.

Hymenochaete potosina Contr.-Pach., R. Valenz., Raymundo & Pacheco, **sp. nov.**

PLATES 3, 4, 7B

MycoBank MB 824899

Differs from *Hymenochaete epichlora* by its smooth basidiome adhered to the substrate, its larger setae with crystals, its production of two types of generative hyphae, its bigger ellipsoid basidiospores, and by its habitat in a tropical dry forest.

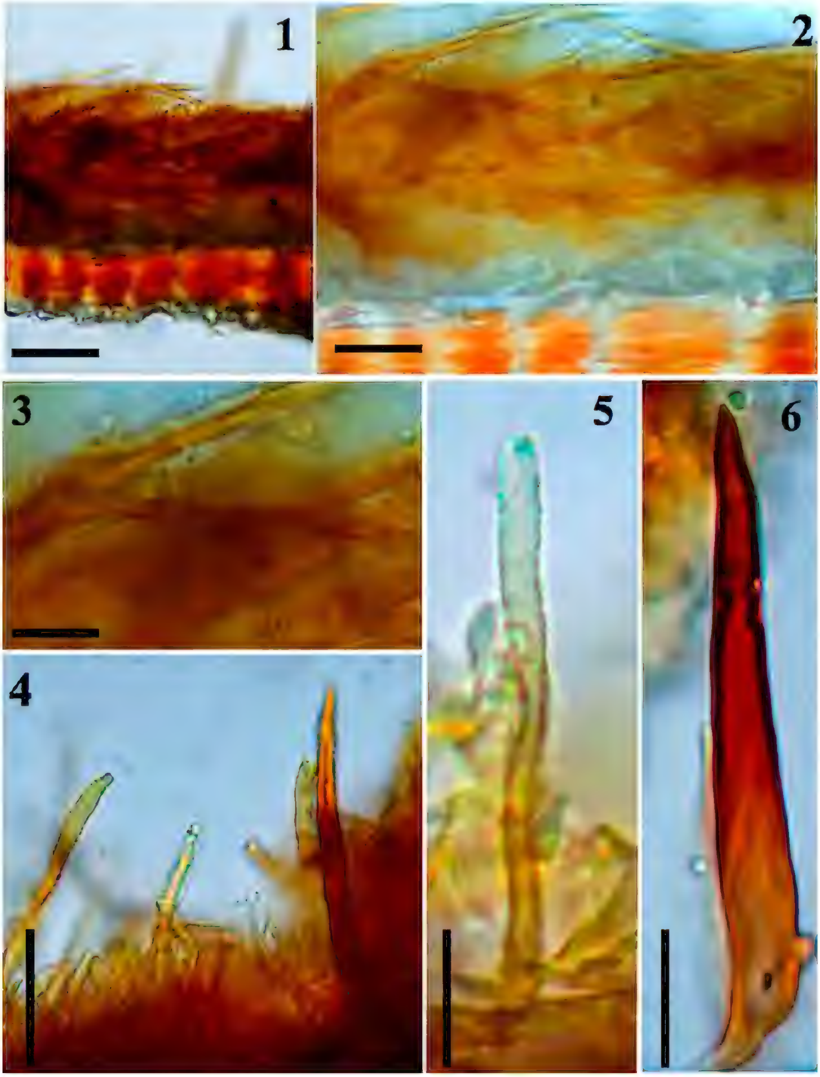

Plate 4. *Hymenochaete potosina* (holotype, ENCB: Valenzuela 13381). 1, 2. Basidiome, cross-section; 3. Hyphal system; 4. Hymenium; 5. Hyphae with some crystals; 6. Setae.

Type: Mexico, San Luis Potosí State: municipality of Río Verde, km 64–65 Ciudad Valles–Río Verde road, 22°52′51″N 99°26′18″W, alt. 630 m, 30 August 2009, R. Valenzuela 13381 (**Holotype**, ENCB; **isotype**, UAMIZ).

Etymology: The specific epithet is a reference to the type locality: San Luis Potosí.

Basidiome resupinate, crustose, adnate, cottony, 150–250 µm thick, 65 × 10 mm, then confluent, strong orange (M: 5YR 6/8, 7/8; KW: 6A8, 6A6). Hymenophore smooth, azonate. Margin determinate, byssoid, yellowish (M: 7.5Y 9/4; KW: 4A7), sterile with setae. Cortex and tomentum absent. Hymenium 76 µm thick, subiculum a 57 µm thick layer composed of intermingled hyphae and setae. Hyphal system monomitic, generative hyphae with simple septa of two types: a) yellowish to yellowish brown, 3–4 µm diam, with slightly thickened (1 µm) walls and crystals sometime present; b) hyaline, 2–4 µm diam, with crystals, projecting above hymenium. Setae 104–120 × 3.2–5.6 µm, subulate, scattered, brownish, with blunt tip, incrusted with crystals, projecting above hymenium 50–70 µm. Basidia 21.6 × 3.2 µm, subclavate, tetrasporic, sterigmata 1.6 µm long. Basidiospores 5.6–7 × 2.4–3 µm, ellipsoid, hyaline, thin-walled, smooth.

Ecology and distribution—Our specimen was collected in the tropical dry forest. The species is known only from the type locality.

Comments—*Hymenochaete potosina* belongs to *Hymenochaete* sect. *Fultochaete* based on the setal layer and context (Léger 1998). Our new species is characterized by its smooth (not cracked) resupinate basidiome with a smooth hymenophore, strong orange color, absence of cystidia, and yellowish crystalline generative hyphae that project above the hymenium. *Hymenochaete potosina* differs from *H. epichlora*, which is distinguished by smaller basidiospores (4–5 × 2–2.5 µm) and setae (35–55 × 5–6.5 µm, without crystals; Léger 1998).

Hymenochaete raduloides Contr.-Pach., R. Valenz., Raymundo & Pacheco, **sp. nov.**
Plates 5, 6, 7.C

MycoBank MB 824900

Differs from other *Hymenochaete* species by the combination of its resupinate basidiome, its hymenophore with well-defined teeth, its pseudodimitic hyphal system pseudodimitic, the absence of a black zone next to substratum, and its habitat in a tropical dry forest.

Type: Mexico, San Luis Potosí State, municipality of Río Verde, km 70 Ciudad Valles–Río Verde road, 22°32′17″ 100°29′13″, alt. 900 m, 1 November 2007, T. Raymundo 1910 (**Holotype**, ENCB; **isotype**, UAMIZ).

Etymology: The specific epithet refers to a hymenophore with flattened teeth.

Basidiome resupinate, closely adnate, corky, 200–400 µm thick, 120 × 28 mm diam, as round patches, confluent, reddish brown (M: 7.5YR 6/10; KW: 5B8).

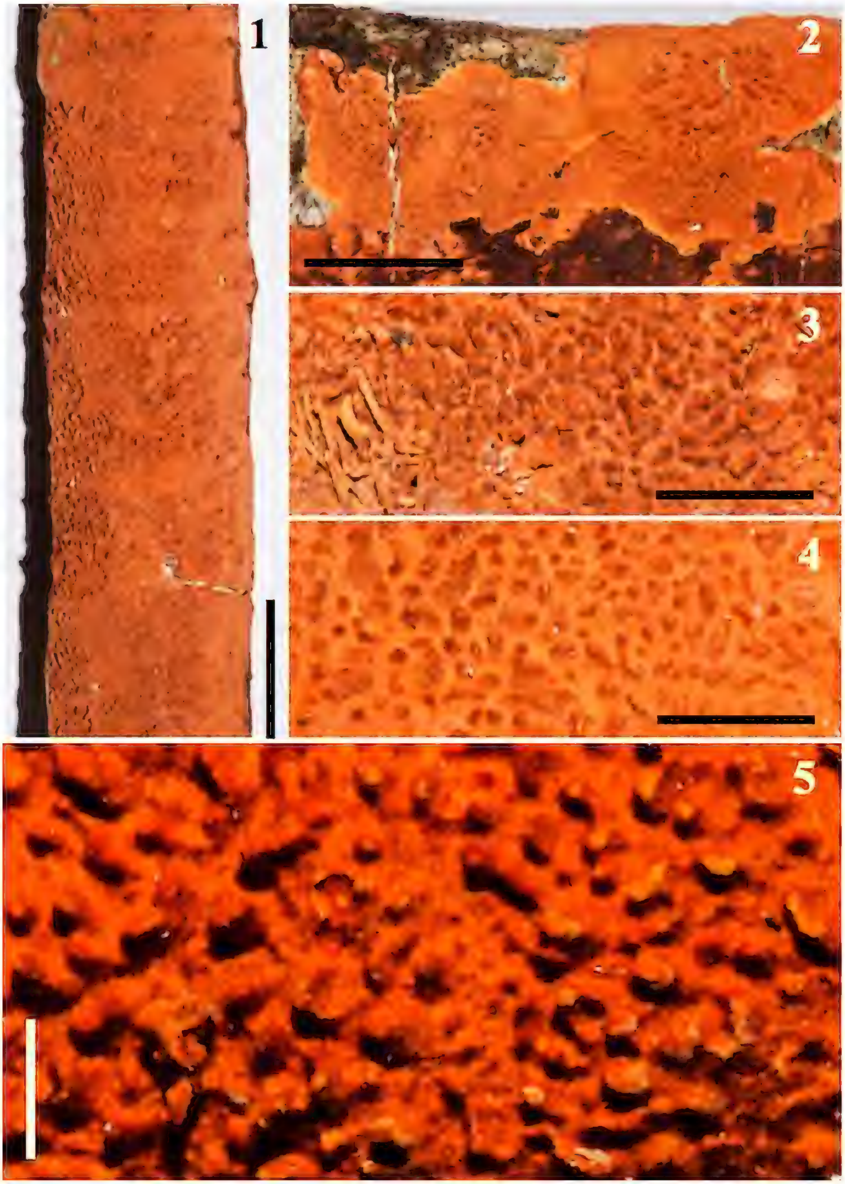

Plate 5. *Hymenochaete raduloides* (holotype, ENCB: Raymundo 1910). 1. Resupinate basidiome; 2. Basidiome on substrate; 3 Hydnoid hymenophore; 4. Teeth of margin; 5. Teeth and setae, magnified.

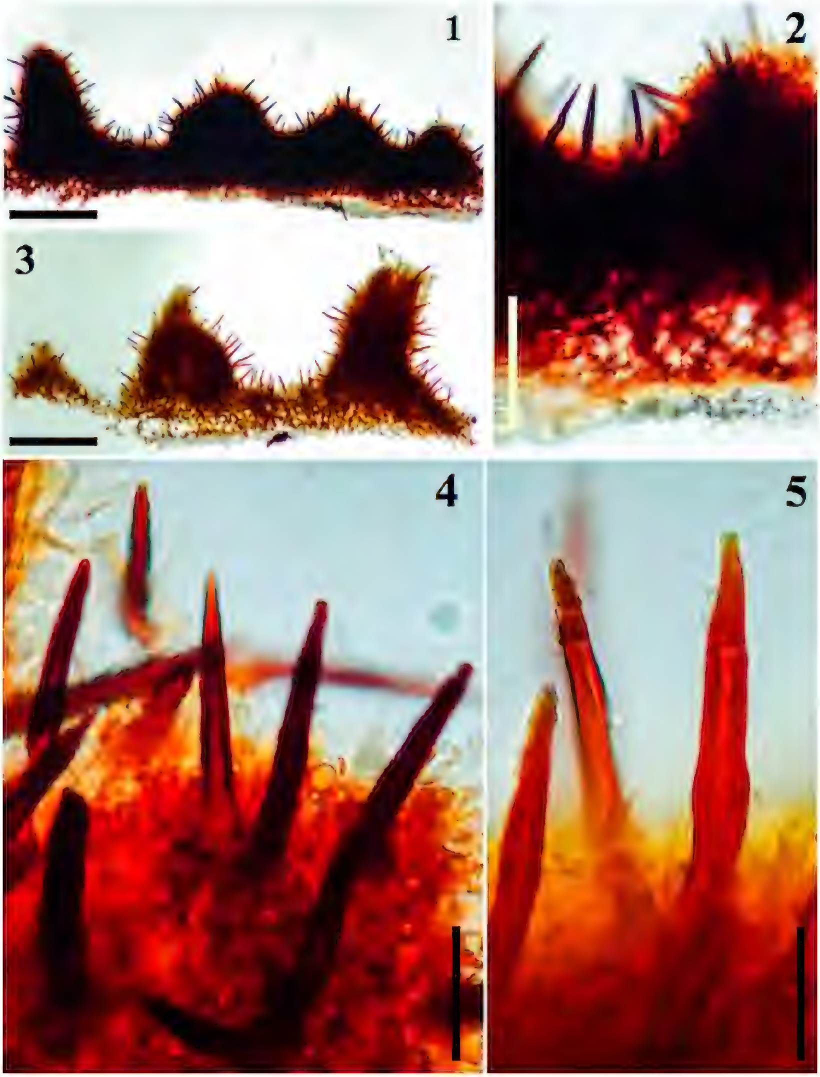

Plate 6. *Hymenochaete raduloides* (holotype, ENCB: Raymundo 1910). 1–3. Basidiome, cross-section; 4, 5. Setae with crystals.

Hymenophore hydnoid to irpicoid, with round to flattened teeth (2–3 mm), sometimes fused in basal parts, with an obtuse to acute tip, <1 mm long, with numerous setae. Margin determinate, abrupt, fibrillose, with setae, sometimes lighter coloured, yellowish (7.5Y 9/4, 5A4). Cortex and tomentum absent.

Hymenium 40–80 µm thick, subiculum 160–320 µm thick comprising the hyphal layer and lacking a dark line above the hymenium. Hyphal system pseudodimitic, with two hyphal types with simple septa intermingled: a) brown, 3–4 µm diam, walls 0.8 µm thick, incrusted with crystals; b) hyphae hyaline, 2–4 µm diam, thin-walled. Setae abundant throughout the hymenium, 76–119 × 7.2–8.8 µm, subulate, vacuolate, brownish, acute. Basidia 8–12 × 2.4–3.2 µm, subclavate, tetrasporic, sterigmata 2.4–3.2 µm long. Basidiospores 4–5 × 1.6–3.2 µm, ellipsoid, hyaline, thin walled, smooth.

Ecology and distribution—Our specimen was collected in dry forest, on dead wood. The species is known only from the type locality.

Comments—This specimen belongs to *Hymenochaete* sect. *Gymnochaete* based on its possession of a setal layer (Léger 1998). It is characterized by a hydnoid hymenophore, spores 4–5 × 1.6–3.2 µm, abundant hymenial setae incrusted with crystals, and a pseudodimitic hyphal system characterized by two sets of hyphae with simple septa: one thin-walled and hyaline, the other thick-walled and brown. Both *H. raduloides* and *H. odontoides* S.H. He & Y.C. Dai [≡ *Hydnochaete tabacina* (Berk. & M.A. Curtis ex Fr.) Ryvarden] produce a hymenophore with well-developed teeth; however, *H. odontoides* is distinguished by producing cortex and tomentum, and by its longer, narrower, allantoid to cylindrical spores (5–6 × 1–1.5 µm; Ryvarden 1982, as *Hydnochaete tabacina*; Parmasto 2001, as *H. tabacina*).

Key to species of *Hymenochaete* in Mexico

1. Hymenophore hydnoid or odontoid 2
1. Hymenophore smooth or with scattered tubercules 3

2. Tomentum absent, tissues pseudodimitic .... *H. raduloides*
2. Tomentum present, tissues monomitic, [dichohyphae & setae
(90–160 × 7.2–12 µm), numerous] .... *H. resupinata*

3. Basidiome pileate, effused-reflexed, or umbonate 4
3. Basidiome effused, margins sometimes slightly elevated 5

4. Basidiome pileate, sometimes branched [usually growing near trees] *H. damicornis*
4. Basidiome pileate without a stipe 7

5. Accessory elements present 6
5. Accessory elements absent 12

6. Dendrohyphidia with thickened walls, without tomentum [with cortex and hyphal
layer, sometime stratose, hyphal and setal layers alternating] ..... *H. pinnatifida*
6. Pseudoacanthophyses numerous, with tomentum, [with cortex and hyphal layer;
two types (small and large) of setae present] .... *H. digitata*

7. Pileus flexible, hyphal layer well developed with loosely arranged hyphae, spores cylindrical, slightly curved, 1.5–2.5 µm diam 8
7. Pileus coriaceous, without hyphal layer or when present densely arranged, spores cylindrical to ellipsoid, 1.2–4.8 µm diam 9

8. Basidiome effused-reflexed, setae rare in sterile hymenium, hyphidia with coiled tips, spores 5.5–8.3 µm long . . . . *H. curtisii*
8. Basidiome sessile-pileate or sessile-umbonate, setae rare or numerous, hyphidia absent, spores 4.5–7 µm long . . . . *H. rheicolor*

9. Setae 4–8 µm diam 10
9. Setae 7–15 µm diam 11

10. Dendrohyphidia present, layer setal stratose [spores ellipsoid, 5–6.5 × 3.5–4.5 µm] . . . . *H. escobarii*
10. Dendrohyphidia absent, setae 40–60 × 5–8 µm, [hyphidia numerous, with encrusted thickened walls] . . . . *H. luteobadia*

11. Basidiome woody, pileal surface velutinous, setae 35–85 × 5–7 µm, spores ellipsoid with one side flattened, 4–5.1 × 2–3 µm . . . . *H. rubiginosa*
11. Basidiome coriaceous, pileal surface hirsute, setae 80–150 × 10–15 µm, spores allantoid, 8.5–11 × 2–2.7 µm [hymenium not cracked] . . . *H. allantospora*

12. Hyphal layer present (sometimes thin) 13
12. Hyphal layer absent (only setal layer present) 18

13. Hyphal layer duplex[basidiome bisected by dark line, basidioles in a sterile hymenium] . . . . *H. leonina*
13. Hyphal layer simple 14

14. Cortex present 15
14. Cortex absent 16

15. Setae incrusted, 70–100 × 8–12 µm, spores cylindrical or sigmoid, 7.5–9 × 2.5–3 µm . . . . *H. americana*
15. Setae not incrusted, 70–90 × 7–9 µm, spores ellipsoid, 5–6 × 3–4 µm . . . . *H. fulva*

16. Setae not encrusted (30–60 × 5–7 µm) [spores ellipsoid, 4.5–5.5 × 3–3.5 µm] . . . . *H. unicolor*
16. Setae encrusted 17

17. Setae 30–60 × 5.5–9 µm, spores 3.5–5 × 1.8–2.5 µm . . . . *H. epichlora*
17. Setae 60–105 × 5–8 µm, spores 4.5–5 × 2.5–3.5 µm . . . . *H. rhabarbarina*
17. Setae 104–120 × 3.2–5.6 µm, spores 5.6 × 2.4 µm, ... *H. potosina*

18. Basidiome stratose 19
18. Basidiome not stratose 20

19. Setae acicular . . . . *H. cifuentesii*
19. Setae not acicular . . . . *H. cinnamomea*

20. Setal tip obtuse, with crystals [hyphidia absent, cortex 30–40 µm, basidiome yellowish brown] . . . . *H. episphaeria*
20. Setal tip acute 21

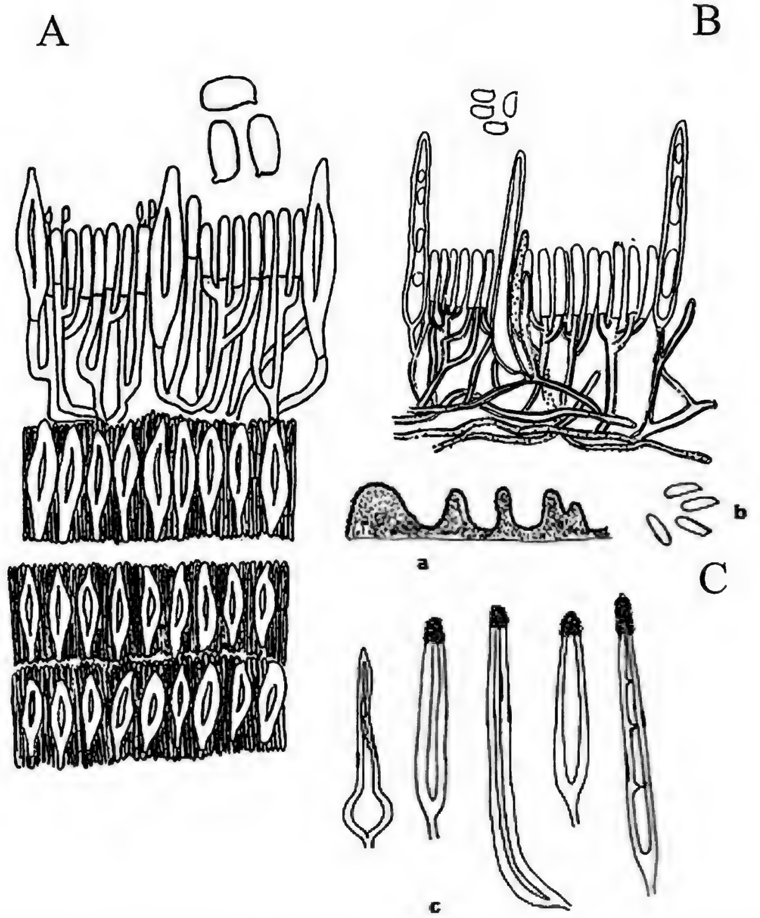

PLATE 7. A. ***Hymenochaete: cifuentesii:*** vertical section of basidiome. B. ***Hymenochaete potosina:*** basidiome, vertical section. C. ***Hymenochaete raduloides:*** a. basidiome, cross-section; b. basidiospore; c. setae.

21 Setae with crystals at apex [hyphidia present or absent,
 hymenium smooth, spores ellipsoid 5–7.5 × 3.5–4 µm] .... *H. cervina*

21. Setae without crystals at apex 22

22. Spores cylindrical to suballantoid, 5–7.5 × 3.5–4 µm
 [basidioles present, hymenial surface velutinous] .... *H. opaca*

22. Spores ellipsoid, 5.5–6.5 × 3–3.5 µm
 [setae numerous, 50–90 × 6–10 µm]............................ *H. carpatica*

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